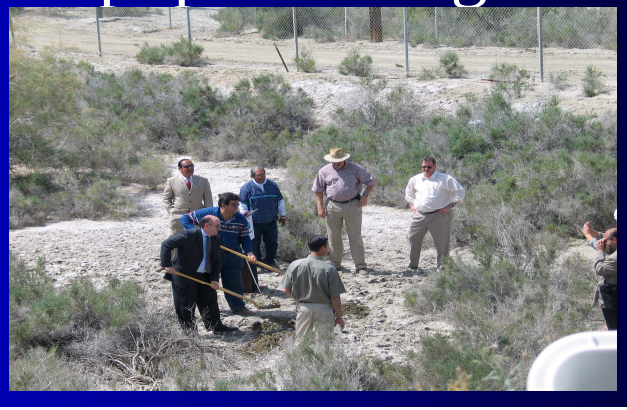
Adaptive Management

- What it is NOT
  - Pilot testing/range finding
  - Scaling up
    - Wetland research on Se removal with plants
    - Reactor size for Se removal with microbes
  - Use of a proven mgmt. tool without evaluation of outcomes and change in protocols to achieve desired results

Role of Adaptive Management in Salton Sea Restoration

- Develop mgmt. tools prior to implementation of a restoration plan, e.g.:
  - Wetlands for NO_3^-/PO_4^{-3} removal (T-M Indians)
  - Algal/fish ponds for nutrient/Se removal
  - Tilapia control to protect pupfish in ag drains



Role of Adaptive Management in Salton Sea Restoration

- Implement specific mgmt. tools for specific process needs
  - Change parameter inputs based on results after specified performance period (20→25ppt salinity), OR
  - Change technology used to achieve process parameters (wetlands →controlled eutrophication for ↓ nutrients)

Recent/Current Research/Monitoring

- Water Quantity/Flows
- Water Quality
- Aquatic Biological Resources
  - Unicellular/invertebrate biota
  - Fishes
  - Waterbirds and Pacific Flyway
  - Ecosystems/foodwebs
  - Diseases (fish and birds)
- Air Quality

Research/Monitoring Needs (Integrated/Long-term)

- Controlled eutrophication and Se removal
- Kent SeaTech Corp. continuation
  - Algal biomass
    - Nutrient assimilation/removal efficiency = ~77%
    - Recycle loops: methane + CO_2 capture

Research/Monitoring Priorities

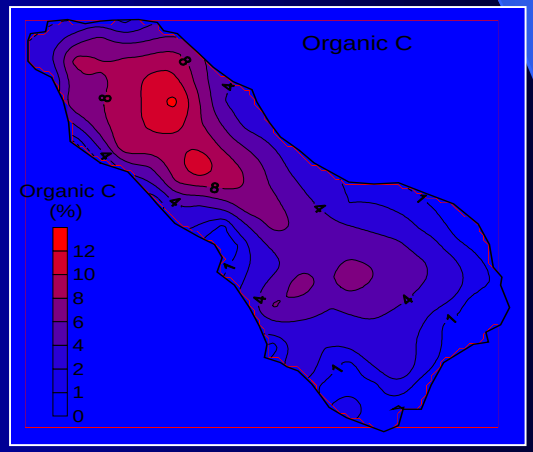
- Tilapia production
  - nutrient removal efficiency only ~25%
  - Risk to pupfish restoration
  - Human health advisory (consumption)
- All flows treated with 4,000 acres of ponds

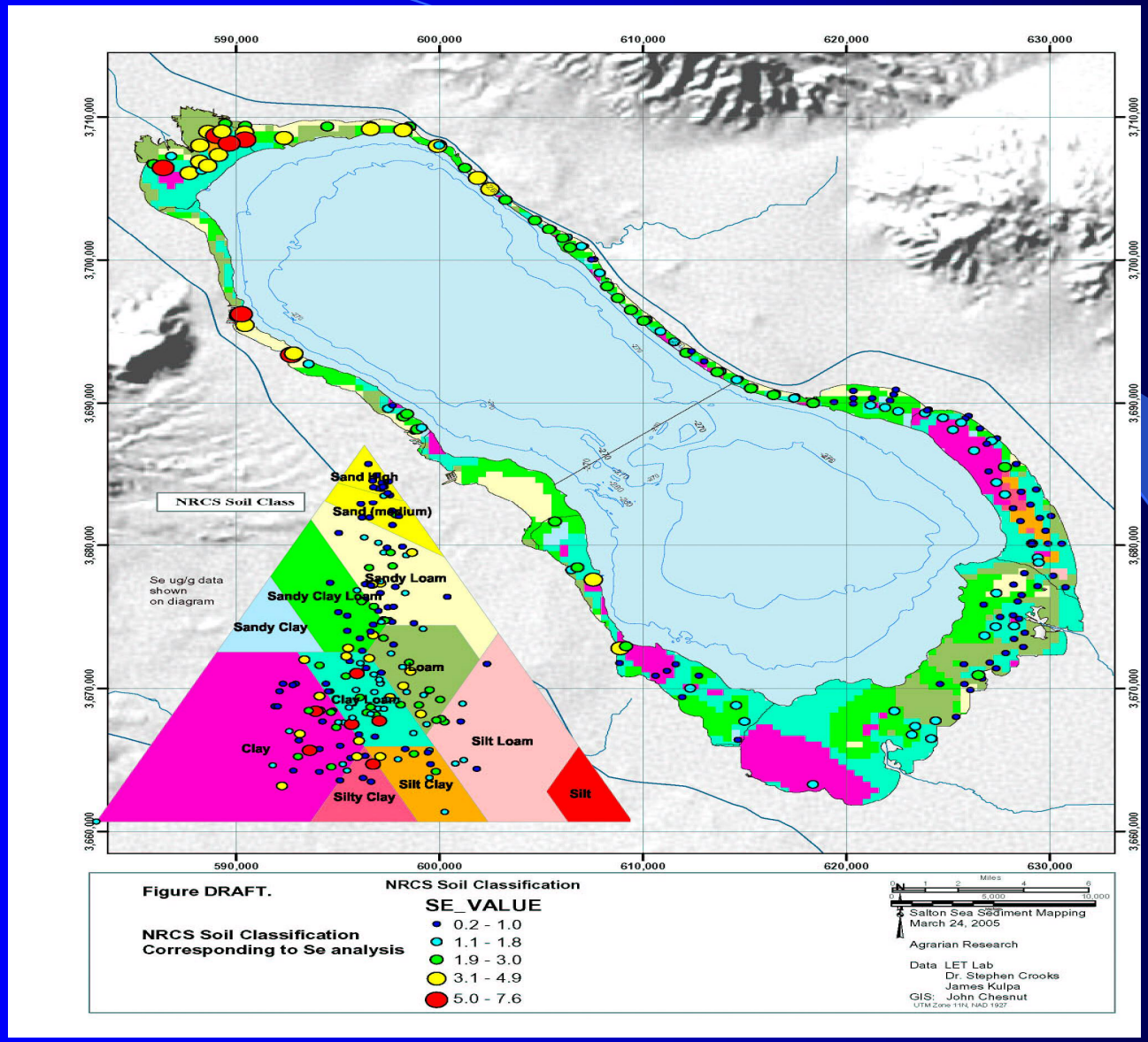
Research/Monitoring Priorities

- Wetland research
  - Shallow ponds waterbird use (USGS/USBR/SDSU)
    - Reproductive success factors in wetland design
    - Se/DDT accumulation rates
    - Salt accumulation impacts on bird survival
  - Agrarian Corp. salinity/Se work

Research/Monitoring Priorities

- Se research/monitoring
  - Drains WQ monitoring (USGS/DFG/IID)
  - Ecosystem bioaccumulation: sediments, H_20, inverts, fish (CH_2M Hill/USGS/Agrarian)
  - Microbial reactor technology (proprietary, stability/seasonality/scale issues)



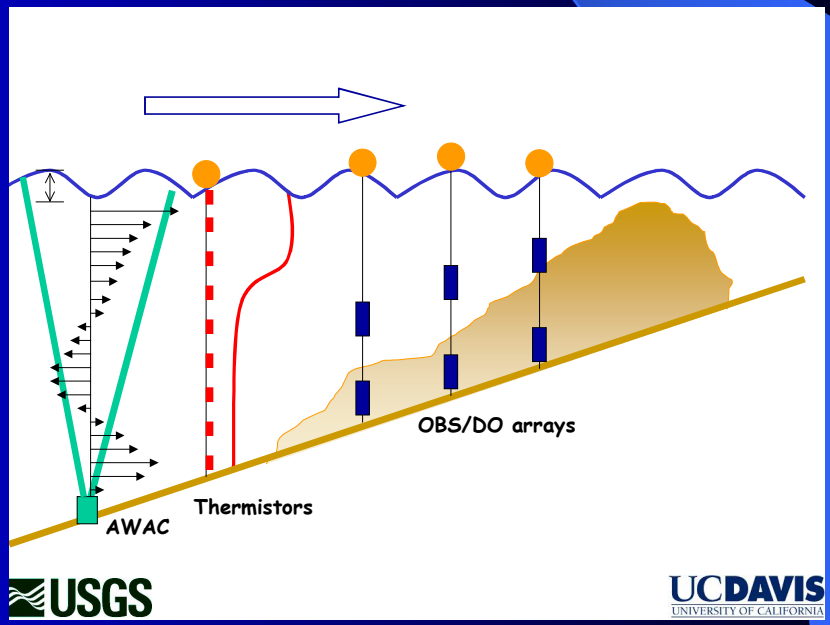

590,000
600,000
610,000
620,000
630,000
3,710,000
3,700,000
3,690,000
3,680,000
3,670,000
3,660,000
NRCS Soil Class
Se ug/g data shown on diagram
Sand (high)
Sand (medium)
Sandy Loam
Sandy Clay Loam
Sandy Clay
Loam
Clay Loam
Silt Loam
Clay
Silt Clay
Silty Clay
Silt
Figure DRAFT.
NRCS Soil Classification Corresponding to Se analysis
NRCS Soil Classification
SE_VALUE
0.2 - 1.0
1.1 - 1.8
1.9 - 3.0
3.1 - 4.9
5.0 - 7.6
Miles
Salton Sea Sediment Mapping
March 24, 2005
Agrarian Research
Data LET Lab
Dr. Stephen Crooks
James Kulpa
GIS: John Chesnut
UTM Zone 11N, NAD 1927

Research/Monitoring Priorities

- Air Quality Needs
  - Expand benthic acoustic work (USGS/USBR)
    - Integrate with soil mapping/sedimentation profiles
    - Relate to wind vector/directionality work
  - Remote sensing (dust storms, points of origin)
  - Quantitative modeling of emissivity (DRI)
  - Study Laguna Salada, Mex.

Research/Monitoring Priorities

- Fish Kills
  - Continue temperature/depth thermistor monitoring (Schladow group upwelling hyp.)



Research/Monitoring Priorities: Fish Kills

- Investigate sulfide/gypsum formations with lab demonstration/confirmation of SDSU work

- Investigate DO (P_{O2}) role
  - microbial decay $\rightarrow$ O_2 depletion
  - plankton photosynthesis $\rightarrow$ supersaturation/toxicity
- Continue NH_3 bioassays with tilapia (UBC)
- Continue fish population surveys (DFG)

Research/Monitoring Priorities (continued)

- Bird Diseases
  - Deep-water habitats: factors known
  - Eared grebe mortality: no more $$
    - Botulism, cholera, New Castle, Se, and algal toxins ruled out
    - $100k's spent already
  - ≥20 ppt salinity prevents most shallow-water disease problems

Recap of Research/Monitoring Needs

- Salinity Control: use of geothermal power to desalinate (USBR, VTE)
- Nutrient Removal
  - Controlled eutrophication (KST)
  - Wetland emergent vegetation (Agrarian)
  - Microbial reactors: NO_3^- (ABMet)
- Se Removal/Monitoring
  - Controlled eutrophication: algae/fish (KST)
  - Microbial reactors (ABMet)
  - Ag drains monitoring (USGS)
  - Ecosystem bioaccumulation (CH_2MHill/Agrarian)

Recap of Research/Monitoring Needs

- Air Quality
  - Benthic acoustic integration with sediment and meterological data (USGS/USBR)
  - Emissivity/Laguna Salada work (Hill, DRI)
  - Remote sensing/satellite imagery (USGS/USBR)
- Fish Kills
  - Continued monitoring (DFG, ERS)
  - Temp./depth profiles modeling (UC Davis)
  - Sulfide/gypsum lab confirmation (SDSU)
  - NH_3 tilapia bioassays (UBC)
  - DO depletion/supersaturation studies (?)

Recap of Research/Monitoring Needs

- Fish Restoration
  - Protect/augment desert pupfish population (DFG)
  - Plan marine species restoration (DFG, Hill)